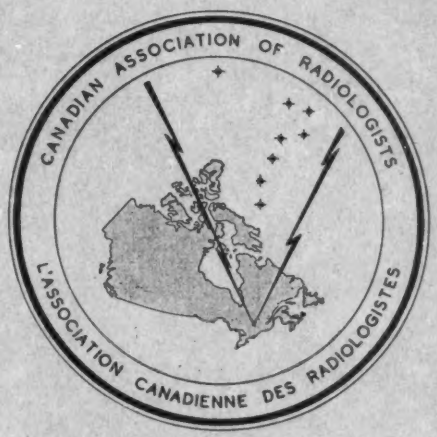
Journal of the Canadian Association of Radiologists

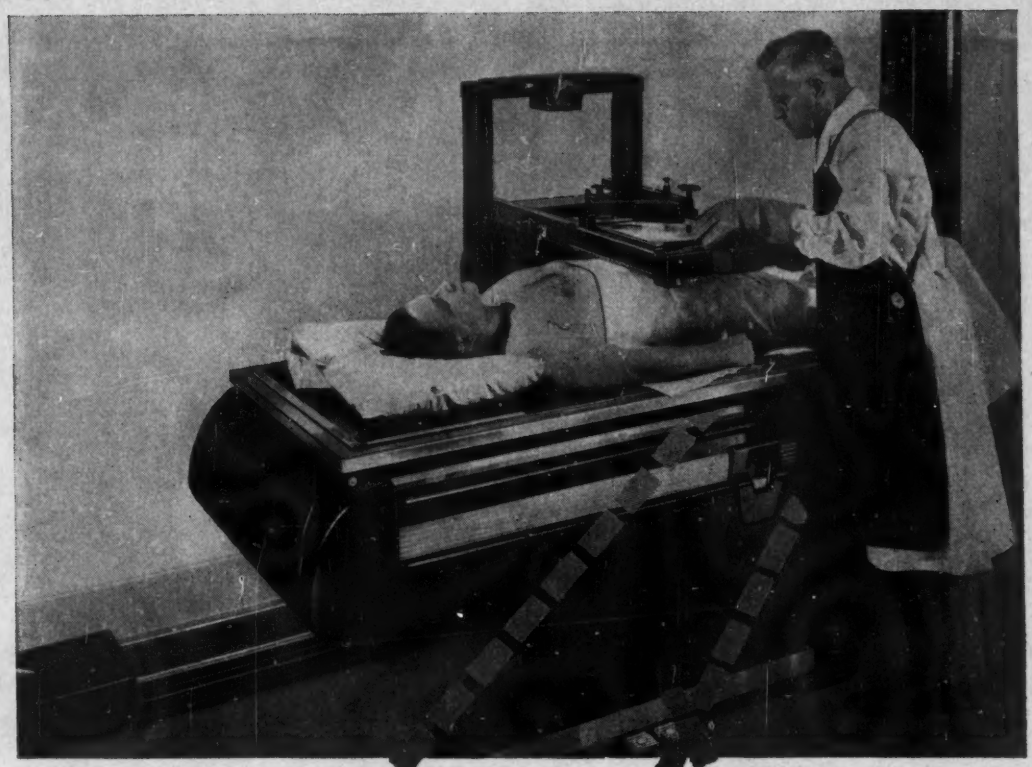
J M. Evans
R G. Moffat
M. Hardie
R W. Nash
G M. Crawford
H T. Barbo



Journal de l'Association Canadienne des Radiologistes

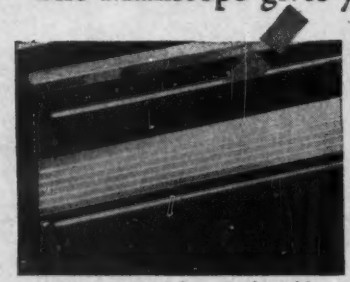
MARCH 1950

No. 1

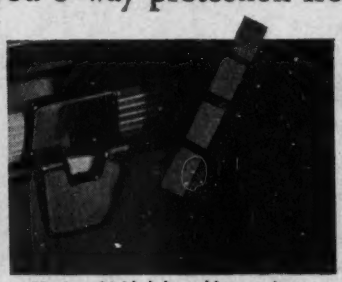


GET THIS ADDED PROTECTION!

The Maxiscope gives you 3-way protection from Scattered Radiation



You're screened from Bucky table opening by folding shutters which operate *automatically.*



You're shielded by table panels to afford better protection from dangerous radiation.

GE's Maxiscope gives you protection all the way to the floor — Yes, even your toes are protected!

Plus These Big Advantages

- More convenient operation — easy accessibility of all locks, all controls.
- Push-button phototiming and push-button technic selector — pay off in time savings — cut down on operator fatigue.
- Hushed, variable speed table angulation. Unobstructed table front — same height as normal hospital cart.
- Plus — the benefit of GE's nationwide service and engineering that stands behind every GE X-Ray installation.
- For informative booklet describing in detail the Maxiscope see your GE representative or write the office nearest you — General Electric X-Ray Corporation, Limited, Montreal, Toronto, Vancouver, Winnipeg.

GENERAL ELECTRIC
X-RAY CORPORATION
LIMITED
MONTREAL TORONTO VANCOUVER WINNIPEG

ANDREW TURNBULL,
President - Préside

JEAN BOUCHARD, M.D
Vice-President - Vi

GUILLAUME GILL, M.D
Hon. Sec-Treas. - S

NORMAN M. BROWN, M
Assoc. Hon. Sec.-T
Sec.-trés. hon. adjo

COUNCILLORS — CONSEIL

British Columbia
Colombie-Britannique
J. S. MADILL, M.D.

Alberta
W. B. PARSONS, M.D.

Saskatchewan
E. W. SPENCER, M.D.

Manitoba
M. K. KIERNAN, M.D.

Northern Ontario
Ontario-nord
L. N. STEWART, M.D.

Western Ontario
Ontario-ouest
M. A. LEVER, M.D.

Central Ontario
Ontario-centre
J. M. DUNSMORE, M.D

Eastern Ontario
Ontario-est
B. T. COLWELL, M.D.

Montréal French-speak
de langue française
JEAN-PIERRE JEAN, M

Montréal English-speak
de langue anglaise
R. G. FRASER, M.D.

Québec
R. LESSARD, M.D.

New Brunswick
Nouveau-Brunswick
H. RIPLEY, M.D.

Nova Scotia
Nouvelle-Ecosse
H. R. CORBETT, M.D.

Prince Edward Island
Ile du Prince Edouard
W. L. MACDONALD, M

Newfoundland
Terre-Neuve
W. J. HIGGINS, M.D.

THE CANADIAN ASSOCIATION OF RADIOLOGISTS
L'ASSOCIATION CANADIENNE DES RADIOLOGISTES

ADDRESS REPLY TO — ADRESSEZ VOTRE RÉPONSE À
SUITE 305 - - 1555 SUMMERHILL AVENUE
MONTREAL 25 - - - - - - - - QUEBEC

15th February 1956

The Library,
University of British Columbia,
Serials Division,
Vancouver 8, B. C.

Dear Sirs:

Re: Your Order No. S-3176

We regret to advise that we have been unable to obtain a copy of Volume III number 2, June 1952 of the Journal of the Canadian Association of Radiologists. We therefore return herewith the above order number.

Yours very truly,

G. A. Mollison

(Miss) G. A. Mollison,
PUBLICATION MANAGER.

GAM:jm
Enc.

EDITORIAL

With the rapid development of Radiology and allied sciences in Canada, the members of the Canadian Association of Radiologists have decided that the time has come to publish a Journal.

The purpose of the Journal primarily is to publish articles pertaining to diagnostic and therapeutic radiology and matters of general interest to the members of the Canadian Association of Radiologists. We hope to extend the scope of the Journal by accepting contributions from other workers such as the biologists and physicists on the physical and biological phases of ionizing radiations.

In the beginning, the size of the Journal will be necessarily small. With this in view, the subject matter should be of satisfactory quality and suitable brevity.

The success of the Journal will depend largely on the interest of and active contribution of papers by the members of the Canadian Association of Radiologists.

THE EDITORIAL BOARD

EDITORIAL

Devant le développement rapide de la Radiologie et des sciences connexes au Canada, les membres de l'Association Canadienne des Radiologistes ont jugé que le temps était venu de publier un Journal.

Le premier but du Journal est la publication d'articles concernant le radiodiagnostic et la radiothérapie, et des articles d'intérêt général pour les membres de l'Association Canadienne des Radiologistes. Nous espérons que le Journal pourra recevoir des articles d'autres collaborateurs tels que des physiciens et des biologistes sur les actions physiques et biologiques des radiations ionisantes.

Au début, le volume du Journal sera nécessairement restreint. C'est pourquoi les sujets traités devraient avoir une qualité satisfaisante et une concision appropriée.

Le succès du Journal dépendra grandement de l'intérêt que lui porteront les membres de l'Association Canadienne des Radiologistes, et de leur active collaboration.

CONSEIL EDITORIAL

THE JOURNAL OF THE
CANADIAN ASSOCIATION OF RADIOLOGISTS

Volume I MARCH 1950 Number 1

TREATMENT OF CANCER OF THE SKIN BY IRRADIATION*

R. C. BURR, M.D., F.R.C.S. (E)
DIRECTOR, ONTARIO CANCER FOUNDATION
KINGSTON CLINIC

In recent years, cancer of the skin has been considered by the Radiation Therapist to be most ideally treated by irradiation. Recently I was shocked when the Surgery Department suggested that excision of basal cell carcinomata of the skin was really the more suitable method of eradicating this disease. This attitude was apparently stimulated by an article published in the *British Medical Journal* on April 30th., 1949 by Sir Cecil Wakeley on basal cell carcinomata in which he recommended surgical excision for all rodent ulcers.

With this in mind, therefore, I thought it was encumbent upon me to try to prove from the records of our clinic what I had already believed to be true, namely, that irradiation was the method of choice for carcinoma of the skin.

In all cases where definite malignancy appears to be present or there is doubt as to the diagnosis, a biopsy is taken using the knife. In previous years when an endotherm loop was used, the pathologist complained that the specimen was often spoiled. The site from which the biopsy is taken is treated with fulguration which rapidly controls the bleeding. If the lesion is raised, it is often found expedient to remove the protruding portion with the endotherm loop so that irradiation may be directed into the base of the tumour.

Sampling of our pathological reports shows basal cell carcinomata and epidermoid carcinomata to be evenly frequent.

The question of the method of treatment is then to be considered. At the present time the surgeon and radiotherapist in most instances agree that irradiation is the method of choice.

The question of use of radium, radon or x-ray therapy must then be considered. In the smaller lesions, that is, those 1.5 cms., and less in diameter, we consider radium to be the method of choice. The radium tubes used have a wall thickness of 1 mm. of platinum, an over-all length of 1.9 cms., an active length of 1.5 cms., over-all width of 2.9 mms., and an equivalent strength of 10 mgms. of radium. The tubes are placed in contact side by side as in a plaque and cover the lesion so that there is a border of apparently normal tissue 2 mms. beyond the actual lesion covered by radium. The plaque is placed in contact with the skin.

Mr. Holloway, our physicist, has calculated the isodose curves for such a set-up as follows using 4, 6 and 8 tubes.

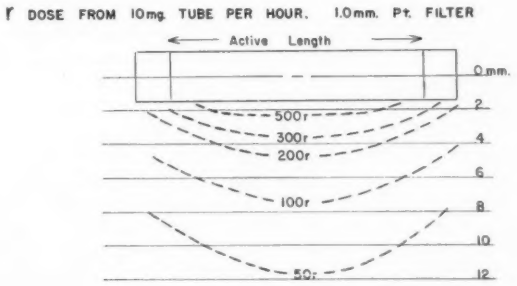


Fig. I—Isodose Curve of 10 mgm. tube. Total length is 1.9 cms., with active length of 1.5 cms., and diameter of 2.9 mms. Distance from the tube is shown in milliametres.

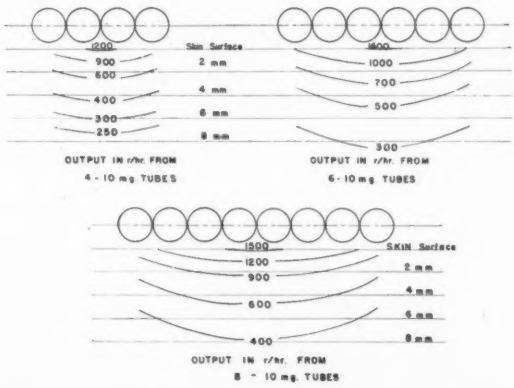


Fig. II—Isodose Curves for different numbers of tubes arranged as a plaque

*Read at Mid-Winter Session of The Canadian Association of Radiologists, January 1950, Montreal.

RADIUM DOSAGE

Tubes on Surface

10 mgms. Outside length 19 mms.	1 mm. wall of platinum Outside width 2.9 mms.	Active Length 1.5 cms.
10 mgm. tube	*Area in mms.*	*Time for 7000r on skin*
2	3 x 12	8 hrs. 00 mins.
3	5 x 12	6 40
4	7 x 12	6 20
5	10 x 12	5 25
6	12 x 12	5 25
7	15 x 12	5 25
8	17 x 12	5 00
9	20 x 12	5 00
10	22 x 12	5 00

TABLE I

Radium dosage showing area in which 7000r is delivered on the skin.

The length of time usually required for such treatments is six hours or less, during which time the patient remains in the clinic. It will be noted that at a depth of 5 mms., the dosage is approximately 2500r.

If the lesions are large, it is thought wise to use x-ray therapy. We use 200 K.V. irradiation filtered through 0.50 mm. copper plus 1 mm. aluminum at a distance of 50 cms. With 0.5 mms. of copper filter the half value layer is 1.5 mms. of copper. Usually the treatment is fractionated over three consecutive days giving from 800r to 1000r on any one day with a total of from 2400r to 3000r. The larger the lesion the smaller the total dose. Care is taken to include some apparently healthy tissue around the lesion in a margin about 3 mms. Here again the larger the lesion the wider the margin that is included. With very large lesions longer fractionation of the treatment seems more satisfactory, and we may use 300r, measured on the skin, on fifteen consecutive days to a total of 4500r.

The reactions resulting from radium and x-ray treatments cannot be differentiated. We usually observe the most severe phase of the inflammation two or three weeks after treatment, and healing is practically complete in all but the very large lesions in two months.

There is a variation in the end results with basal cell carcinomata compared with epidermoid carcinomata, as basal cell tumours have a higher cure rate.

A survey of our own cases is shown in

TABLE II

CARCINOMA OF THE SKIN

Total cases treated	699
Died of Intercurrent Disease	165
Lost	61
Cases suitable for this survey	473
Expired from carcinoma of the skin	4
Alive and well and free of disease over 5 years	469
Percentage of Five Year Cures	99%

Of those cases which expired, three had squamous cell carcinoma and in one the diagnosis was basal cell carcinoma.

The following table shows the deaths from carcinoma of the skin:

TABLE III

DEATHS FROM CARCINOMA OF THE SKIN

1933-1943

Site	Pathological Report	Stage Clinical
Carcinoma of the middle ear	Squamous cell	III
of the buttock	Epidermoid	III
of the auricle	Squamous cell	I
skin of the leg	Basal cell	I

CONCLUSIONS

(1) The time required for treatment of a carcinoma of the skin by irradiation is no greater than that required for surgical excision and the patient may carry on his work missing only one day from his regular duties.

(2) The result of Five Year Survivals following treatment with irradiation shows a very high cure rate. Surgical figures thus far published do not show as favourable a rate.

(3) The rare complications of irradiation, such as telangiectasis and atrophy of the skin with chronic ulceration may prove troublesome later but if they do, repair by plastic surgery is adequate.

(4) The question of radiosensitivity of squamous cell carcinomata has been considered. It is admitted that squamous cell carcinomata are more difficult to cure. The same conclusion, however, may be drawn if the lesion is treated by surgery.

(5) Irradiation remains the method of choice in the treatment of Cancer of the skin.

LA CONTACTHÉRAPIE DANS LES LÉSIONS MALIGNES DE LA PEAU ET DES MUQUEUSES*

ORIGÈNE DUFRESNE, M.D.
DIRECTEUR, INSTITUT DU RADIUM, MONTREAL
ET
GERMAIN PINSONNEAULT, M.D.
ASSISTANT DIRECTEUR, INSTITUT DU RADIUM, MONTREAL

La roentgenthérapie au contact, par sa simplicité, sa rapidité d'action et d'application et son efficacité, représente un des plus importants perfectionnements apportés depuis 25 ans dans le domaine du traitement des cancers par les radiations. On a beau alléguer qu'elle n'est qu'un mode particulier de la roentgenthérapie superficielle, qu'elle se pratiquait en ébauche longtemps avant sa forme actuelle, qu'elle ne s'adresse qu'à une certaine variété anatomique de tumeurs, et que toutes les guérisons qu'elle fournit peuvent théoriquement s'obtenir par d'autres méthodes, la roentgenthérapie au contact, telle que mise au point par Chaoul et par Van der Plaats, n'en reste pas moins le mode idéal de traitement du plus grand nombre de cancers curables de la peau et des muqueuses.

Dans le traitement en masse des épithéliomas des téguments qui affligent une catégorie toujours croissante de malades qu'on appelle malades de dispensaire, la roentgenthérapie au contact est, et restera, l'outillage excellemment économique et pratique. Si les radiologistes plus anciens voulaient se rappeler la somme de manipulations que représentait, il y a 20 ans, le traitement des cancers qui relèvent aujourd'hui de la contacthérapie, et s'il pouvait être donné aux chirurgiens de peser, en dollars et en tissus, le coût de leur rivalité avec les radiologistes dans ce domaine, les bienfaits de la contacthérapie seraient appréciés à leur juste valeur.

Notre expérience de la roentgenthérapie au contact date de 10 ans. D'octobre 1939 à octobre 1949, nous avons traité par cette méthode 1,854 malades. Sur ce nombre, 696 présentaient des lésions malignes des téguments. Parmi celles-ci, nous relevons 355 épithéliomas de la peau, 223 épithéliomas de la lèvre, 30 des paupières, 21 du palais, 20 de la langue, 13 de la face interne de la joue, 12 du plancher buccal, 5 de l'amygdale, 5 des gencives, 10 du sein, 1 de la verge et 1 de la vulve.

Les lésions traitées étaient des lésions cliniquement peu infiltrantes, d'une épaisseur toujours inférieure à 10 millimètres. Un certain nombre d'entre elles comportaient des métastases ganglionnaires qui ont été évidemment traitées par d'autres procédés. Un certain nombre aussi étaient constituées par des récidives développées sur des tissus déjà irradiés d'autres façons (curiethérapie interstitielle ou juxtatégumentaire).

Les indications qui ont présidé à la sélection des cas à traiter par rayons X au contact, étaient simplement l'accès immédiat de la tumeur sans interposition de tissu sain, et la faible épaisseur des lésions. Le degré de malignité, basé sur des particularités histologiques, n'est jamais intervenu, ni dans le choix de la méthode, ni dans les modifications de la technique.

Durant la première année, nous nous sommes évertués à varier les techniques, de manière à nous faire une opinion sur leur efficacité respective. Nous avons ainsi traité un certain nombre de lésions au moyen de doses plus ou moins espacées ou fractionnées. Nous n'avons pas tardé à nous croire autorisés à penser que les lésions traitées par doses fractionnées ne guérissent pas mieux, ni plus souvent, que celles traitées en une fois par doses massives.

Comme nous ne disposions, à cette époque, que d'un appareillage Philips, et que ce dernier fonctionne sous une tension *fixe* de 50 Kv., nous ne pouvions modifier la qualité du faisceau que par l'adjonction de filtres, et agir sur la distribution de l'énergie, au sein des tissus, qu'en variant la distance anticathode-peau. C'est ce que nous avons fait dans les premiers temps. Nous traitions alors les lésions les plus minces à deux centimètres et à feu nu, et les lésions les plus épaisses, à quatre centimètres, avec un filtre d'un millimètre d'aluminium. Nous nous sommes bientôt aperçu que les lésions les plus minces, qui semblaient justifiables, à première vue, de la technique à feu nu, à deux centimètres, récidivaient aussi souvent, sinon plus, que celles plus épaisses, traitées à quatre centimètres. Nous avons donc abandonné, pour les lésions malignes, la pratique à deux centimètres, à feu nu.

Il restait ainsi à notre disposition, le mode à deux centimètres, et le mode à quatre centimètres, avec ou sans filtre.

Si on examine, avec pièces en main, les conditions d'utilisation de l'appareillage Philips, à deux centimètres, avec ou sans filtre, on ne tarde pas à se rendre compte que l'outillage actuel présente de sérieux inconvénients.

Dans le cas où la superficie de la lésion est inférieure à la surface radiante totale de l'appli-

*Travail présenté à la réunion d'hiver de l'Association Canadienne des Radiologistes tenue à Montréal en janvier 1950.

cateur, et où elle nécessite par conséquent l'usage des localisateurs fournis avec l'appareil, on constate qu'on est fortement exposé à faire l'irradiation à côté de la lésion ou, ce qui est plus grave, qu'on manque des moyens de s'assurer que la dose donnée a été très exactement répartie sur la lésion. Cet écueil est à peu près fatal si on administre le traitement avec le tube fixé sur son support.

Il est difficile en effet de conserver la tête ou un membre dans une immobilité fixe, quand on n'a pas de point de repère, et un glissement de quelques millimètres de la surface à traiter sur l'applicateur suffit alors à gâcher le traitement.

Ce danger est moins grand si on suit le mode de procéder de Van der Plaats, qui consiste à maintenir le localisateur en place avec la main gauche, et à maintenir le tube dans le localisateur, au moyen de l'épaule et de la main droite. Mais même dans ces conditions, on reste exposé à des erreurs.

Certains radiologistes utilisent des feuilles minces de plomb ou de caoutchouc plombeux, percées d'orifices de différentes formes et de différentes grandeurs, par où la lésion seule est mise à découvert. Mais, à notre avis, la cache de plomb ou de caoutchouc plombeux est un objet incommode, difficile à garder propre, difficile à appliquer et difficile à maintenir sur des surfaces anguleuses ou anfractueuses.

Si on utilise les filtres et les localisateurs faisant partie de l'outillage Philips, on constate en outre que le filtre peut facilement se coincer dans le localisateur. Il arrive alors que le tube n'est plus en contact avec la lésion et qu'on donne un traitement à trois ou quatre centimètres, alors qu'on croyait le donner à deux.

Il peut arriver enfin qu'on oublie le filtre, et qu'on donne une dose cinq à dix fois supérieure à celle qu'on avait en vue.

Pour toutes ces raisons, nous en sommes arrivés à nous servir d'une seule et unique qualité de rayons, (ceux fournis à quatre centimètres sans filtre), pour toutes les lésions malignes dont l'épaisseur est compatible avec la roentgenthérapie au contact.

Nous pensons qu'un mode de traitement dont la caractéristique essentielle est la rapidité, doit comporter une technique simple, sans quoi il expose à des avaries.

Le tube Philips à quatre centimètres de distance, et sans filtre, fournit un rayonnement, qui, à la dose massive de 4 ou 5,000r, appliquée en 100 ou en 120 secondes, est apte à guérir complètement et définitivement la presque totalité des épithéliomas accessibles de la peau et des muqueuses dans leurs localisations primitives et bien entendu, dans leurs formes peu infiltrantes.

Le traitement pratiqué de cette façon donne lieu à une radioépidermite exsudative qui débute trois jours après l'application, atteint son maximum en quinze ou dix-huit jours, et guérit au bout de six à sept semaines, avec un minimum de cicatrice.

Les modifications tissulaires engendrées par une dose cancéricide de rayons X caustiques sont extraordinairement précoces et sélectives. Nous avons fait des biopsies en série, échelonnées de quart d'heure en quart d'heure, sur des épithéliomas baso-cellulaires ayant subi une irradiation massive de 4,500r. La durée du traitement était de 120 secondes, la tension de 50 Kv., le débit de 2 milliampères, la distance de 38 millimètres, la filtration totale équivalente à 0.2 mm. d'Aluminium, et la qualité exprimée en C.D.A. de 0.3 mm. d'aluminium. Le diamètre des champs irradiés variait de 10 à 25 millimètres. Le taux de transmission d'un tel rayonnement est, d'après Frilley et Dauvilliers, de 53% à un quart de centimètre de profondeur.

Dès la deuxième heure qui suit une telle application, on note dans les fragments de tumeurs examinés, une disparition totale des figures de mitoses. Cette particularité est frappante, et antérieure à toutes les modifications qui se produiront par ailleurs et par la suite, aussi bien en tissu sain, qu'en tissu néoplasique. Les choses se passent comme si la prolifération cellulaire cancéreuse était à peu près instantanément sidérée, et comme si la résorption des éléments néoplasiques était extraordinairement rapide.

Cette constatation nous a incités à pratiquer systématiquement le traitement avant la biopsie. Nous irradions d'abord la tumeur, et aussitôt après, nous en prélevons un fragment. Nous sommes restés de ceux qui croient, *à tort ou à raison*, que la biopsie peut, *dans certains cas*, aider à la prolifération et à la dissémination des cancers. Cette attitude, devant un problème actuellement insoluble, a au moins le mérite de s'inspirer de l'intérêt du malade, et non pas seulement, de considérations hypothétiques touchant le mode de dissémination des tumeurs.

Mais si on irradie avant de biopsier, le bon sens et la logique commandent qu'on s'applique à donner la dose cancéricide qui produit le minimum de dégâts dans les tissus sains, pour le cas éventuel où cette dose serait donnée en l'absence de lésion véritablement maligne.

Nous croyons être en position d'affirmer qu'une dose de radiations de 4,000r, sur une surface de cinq centimètres carrés, ou qu'une dose de 5,000r, sur une surface d'un centimètre carré, est une "*dose de tout repos*" pour les tissus sains, lorsque ces radiations sont distribuées à quatre centimètres de distance, et qu'elles sont produites à 50 kilovolts, avec une filtration inhérente équivalente à 0.2 millimètre d'aluminium.

Nous croyons de plus qu'une telle quantité de radiations de la qualité mentionnée est suffisante pour venir à bout, en une seule application; de la

généralité des épithéliomas dont l'infiltration totale est inférieure à 10 millimètres.

Si dans certains cas exceptionnels, on a des raisons cliniques de penser que la guérison est incomplète sur certains points, ces *points peuvent être irradiés de nouveau au bout de deux mois*. On utilise alors la même dose, mais des champs différents, plus étroits.

Nous avons traité de cette façon au delà de 600 malades. Sur 280 épithéliomas de la peau, 13 seulement présentèrent, deux mois après traitement, des lésions douteuses qui justifiaient de nouvelles applications.

Sur 214 cancers de la lèvre, nous avons relevé 9 récidives locales et six morts par métastases avec des lésions primitives cliniquement guéries.

Sur 30 cancers des paupières, nous comptons 24 guérisons qui se maintiennent depuis une période variant d'un à neuf ans.

Sur 21 cas de cancers du palais, vus et traités en dix ans, nous comptons 10 morts et 11 guérisons. Ce qui constitue un progrès manifeste, en comparaison des résultats obtenus par d'autres méthodes.

Nous ne voulons pas insister outre mesure sur des statistiques de guérisons qui sont toujours difficiles à établir, délicates à comparer, et doublement délicates à interpréter. Nous préférons consacrer le reste du temps qui nous est alloué, à certaines considérations sur l'appareillage, la technique et le rôle de la contacthérapie dans la lutte anticancéreuse.

La roentgenthérapie au contact est une méthode dont la caractéristique essentielle est l'utilisation d'un faisceau de rayons **X**, dans des conditions physiques telles que l'énergie de ces rayons est absorbée à peu près uniquement par une épaisseur variable de la couche *la plus superficielle des tissus*. Il s'agit en somme, d'une cautérisation, mais d'une cautérisation *sélective*, où la radiosensibilité particulière des tissus pathologiques néoformés est mise à profit.

Chacun sait que le but de la contacthérapie s'obtient par la réduction du kilovoltage, la réduction de la filtration, et la réduction de la distance.

Toutes les machines existantes ont tiré un parti plus ou moins heureux de l'un ou de l'autre, ou de ces trois facteurs physiques.

Toutes satisfont plus ou moins complètement aux exigences théoriques de la contacthérapie. Les unes ont une excellente marge de qualité, avec une flexibilité réduite; les autres ont une excellente flexibilité, avec une marge de qualité qui laisse à désirer. Quand on considère le choix des machines à contacthérapie actuellement sur le marché on dirait qu'on s'est appliqué à tempérer le mérite des qualités de l'une, par les défauts de l'autre. Il n'existe pas, à notre avis, d'appareillage qui réponde également bien à tous les besoins cliniques. Chaque machine actuelle ne répond idéalement bien qu'au traitement d'une certaine variété anatomo-clinique de lésions.

Une bonne machine à contacthérapie devrait, à notre avis, avoir: une tension variable de 15 à 75 kilovolts; un fort débit, pour réduire au minimum la durée de certaines applications très délicates; une très faible filtration inhérente pour pouvoir, le cas échéant, utiliser des radiations très molles; une très faible distance focale pour pouvoir tirer tout le parti désirable de telles radiations. On devrait pouvoir varier la filtration, la distance et le kilovoltage de manière à limiter l'action des radiations sur une épaisseur variable de tissu.

Le tube, qu'il soit du type Philips, qui radie à travers la cathode, ou du type Siemens, qui radie à travers l'anode, devrait être de forme régulièrement cylindrique, dans son extrémité active, et de diamètre étroit.

On devrait disposer de tubes dont l'extrémité pourrait irradier longitudinalement, comme le tube Philips, et d'autres, dont l'extrémité pourrait radier obliquement, ou même transversalement, dans le genre du modèle conique de Siemens.

Le tube muni de son étui protecteur et fixé à l'extrémité d'une gaîne flexible contenant le cable de haute tension, les fils d'alimentation du filament et les conduites de refroidissement, devrait être utilisé et manipulé comme une lance d'arrosage au bout de son boyau. Le meilleur et le plus élaboré des supports ne vaut pas les mains de l'opérateur qui suivent le malade dans les déplacements involontaires qu'il peut faire au cours de l'irradiation. Il ne faut pas en effet perdre de vue qu'en contact thérapie le temps se chiffre en secondes, et le champ, en millimètres.

Pour compléter l'appareil idéal que nous concevons, nous dirons que la filtration, la distance, la forme et la dimension des champs devraient être pourvues à même un jeu très varié d'applicateurs spéciaux, qui se visseraient sur l'extrémité active de l'étui protecteur, contenant le tube.

Cet appareil de contacthérapie, vu en rêve, fera peut-être sourire les constructeurs à cause de la somme de difficultés techniques qu'il représente, mais sa réalisation s'impose si on veut tirer de la méthode tout ce qu'elle peut donner.

En terminant, nous voudrions dire un mot du rôle de la contacthérapie dans la lutte contre le cancer. On ne saurait s'exagérer toute l'importance d'un appareil de contacthérapie dans l'équipement de ces unités mobiles, inaugurées récemment dans certains états, et affectés au dépistage du cancer dans les petits centres et les campagnes éloignées. Imaginons le nombre de guérisons qu'une seule de ces petites machines, utilisées à bon escient, pourrait récolter parmi la légion d'épithéliomas cutanéo-muqueux qui infestent les populations rurales et qui nous

arrivent à des phases de curabilité problématique, ou d'incurabilité évidente. Combien de vies humaines, combien de jours d'hospitalisation, combien d'interventions laborieuses, combien d'applications coûteuses de radium et de rayons X, combien de personnel et combien de dollars pourraient être épargnés, si nos gouvernants voulaient se pencher sur ce coin très simple et très facile à solutionner du grand problème social des cancéreux.

CONCLUSIONS

(1) Il ne faut pas plus de temps pour irradier un cancer de la peau que pour en faire l'exérèse, et le malade peut satisfaire au traitement, en manquant une seule journée d'ouvrage.

(2) Les résultats de survie après cinq ans nous montrent un très fort pourcentage de guérisons, supérieur à celui des statistiques chirurgicales publiées jusqu'à aujourd'hui.

(3) Les rares complications des radiations comme les télangiectasies et les atrophies de la peau avec ulcères chroniques sont susceptibles de causer des ennuis par la suite, mais si le fait se produit, on peut toujours y parer par la chirurgie plastique.

(4) La radiosensibilité des épithéliomas spino-cellulaires a été discutée. Il est admis que ces derniers sont plus difficiles à guérir. La même particularité doit cependant être prise en considération dans le traitement chirurgical.

(5) L'irradiation reste le traitement de choix des cancers de la peau.

SUMMARY

By its simplicity of application, rapidity of action and effectiveness, Contact-Therapy represents one of the most valuable improvements of radiation cancer therapy in the last 25 years.

It is a method of treatment in which the energy of x-rays is almost completely absorbed by the superficial layer of tissue. Special x-ray tubes, working with low voltage (50kV), at a short distance (2-4 cm.) are used for this purpose.

Our experience with Contact-Therapy started ten years ago.

A massive dose of 4000 to 5000r units, given at 4 cm., without filter, in 100 or 120 seconds, will probably cure completely almost the total amount of superficial carcinomas of the mucous membrane and of the skin.

Such a treatment gives way to an exudative radio-epidermitis which starts 3 days after application, obtains its maximum in 15 to 18 days and heals after 6 to 8 weeks.

Contact-Therapy would be an important accessory in a mobile unit used to fight cancer in small centres or rural districts.

SPOT FILM TECHNIQUE IN ROENTGEN EXAMINATION FOR DUODENAL ULCER*

ARNOLD BERNSTEIN, M.D.

THE HOMOEOPATHIC HOSPITAL OF MONTREAL

The necessity of combined fluoroscopic and radiographic studies in roentgen examination of the duodenum has become generally recognized. It is the merit of Akerlund[1] and Berg[2] to have developed a technique of examination of the duodenum, which, literally translated, was described as "aimed, coned, spot films with dosed compression". By this method, fluoroscopic observation and film recording are so closely integrated that they have become inseparable, not only adding, but multiplying the diagnostic results. The frequently discussed question, which is more important, fluoroscopy or radiography in the differential diagnosis of duodenal ulcer, has become more or less academic where principles in technique as developed by Akerlund and Berg are followed in all detail. I think that it might be useful to discuss here, in some detail, the significance of spot film technique in roentgen examination for duodenal ulcer and the role fluoroscopy plays in it.

What are the essential features of this so-called "spot film technique" which gradually has proven its extreme usefulness in the various fields of roentgen diagnosis? What spot film technique means in general is, first of all, a question of meaning—that is, it depends on what one thinks when using the word. When we speak of a spot film of the first lumbar vertebra, for example, we think of a small selective radiograph obtained by a narrow cone—no fluoroscopy is involved. A spot film in bronchography or myelography does not necessarily imply a cone, but means a film taken under fluoroscopic control at a certain diagnostically important moment, i.e., when the contrast visualization is optimal. When using spot film technique in cholecystography, one thinks of the same procedure, but here again a cone is necessary, and, in addition, one must apply various degrees of compression and take films at different angles of obliquity in a selective way to achieve its greatest usefulness. Spot films in roentgen examination for duodenal ulcer implies all that was said of gall bladder studies with two additional and vital features, of which one is a mere technical problem, while the other is a medical art, requiring both extensive pathological anatomic knowledge and the greatest technical skill as well, which can only be acquired by long experience and study.

The one is now practically solved. The problem is that of creating a device which allows fluoroscopic observation through a narrow cone attached to the screen, the use of compression by cone and manual palpation, and immediate film recording by instantaneous exposure. I must emphasize *instantaneous exposure* and specify that the time allowed between fluoroscopic observation and radiography should not exceed fractions of a second. The importance of this short interval is apparently not realized by several manufacturers of this equipment, and by some radiologists who have suitable equipment at their disposal but do not use such short timing in cases where it is vital. Instantaneous exposure is nowhere more important than in roentgen examination of the duodenum. In this region we are confronted with a task of making photographic records of certain appearances which are extremely fleeting, especially so in the case of ulcer, where there is often the so-called "irritable cap". I would rather like to call it "evasive", and I think this evasiveness is painfully known to every radiologist. It is a suggestive sign of disease.

It is an important part of the radiological examination to counteract this transient contrast visualization by manipulation and compression with a spot film device, which must be extremely manipulative. But even when one is successful in making the radiological image of longer duration by manipulation, the optimal moment for producing the most characteristic radiological appearances still remains very short in many instances, which one must count in fractions of a second. By delaying the exposure, one may miss an important phase, or one might have to take too many exposures in order to record what one has seen on the screen. In fact, what one attempts to produce with spot film technique is not a long series of single films in rapid succession, but rather a very few films, taken at the moments of optimal diagnostic importance. However, it is not only the moment that must be optimal, but also the projection. One must look at the duodenal cap at all possible

*Part of a paper read at the Mid-Winter Session of the Canadian Association of Radiologists, January 1950, Montreal.

angles, both fluoroscopically and radiographically, and, as Holzknecht used to describe it so vividly, "with flowing rotation" of the patient. This continuous turning of the patient back and forth through all angles of obliquity, introduces in fluoroscopy what one might call "three dimensional thinking". It is this three dimensional thinking that is required in successful roentgenological exploration of the duodenal cap more than in any other part of the gastrointestinal tract; yet nowhere in the whole field of radiological diagnosis is it more neglected.

Spot films should not be taken aimlessly. The exposure should be timed for the precise moment and for the exact angle. There must be an optimal degree of contrast filling, regulated by manipulation with a pressure cone, and, if necessary, influenced by varying pressure from the hand of the examiner, according to whether one is studying profile projections or relief structures. (*Figs. 1 and 2.*) As Berg expressed it, radiography should begin where fluoroscopy ceases to be reliable. This, of course, is a dictum which today nobody will doubt who has any fluoroscopic experience. However, I should like to add—and this is not always fully realized—the art of roentgen examination for duodenal ulcer must never be restricted to the spontaneous changes occurring in the duodenal cap as shown on films. This is the half world of duodenal radiology. The refinement is supplied by the technique of palpation and compression under fluoroscopic observation, which evokes duodenal scenes not otherwise obtainable by all the skill known to man.

One must have certain clear conceptions of what one might expect to see of structural and morphological detail. One must imagine how that detail will be reflected in the shadow appearance of a barium mold which is being molded at the same time by the general tone of the duodenum, by peristalsis, by varying and static changes of the surface relief, with additional molding created by the hand of the examiner and his compression cone. It is only such knowledge and logical three dimensional

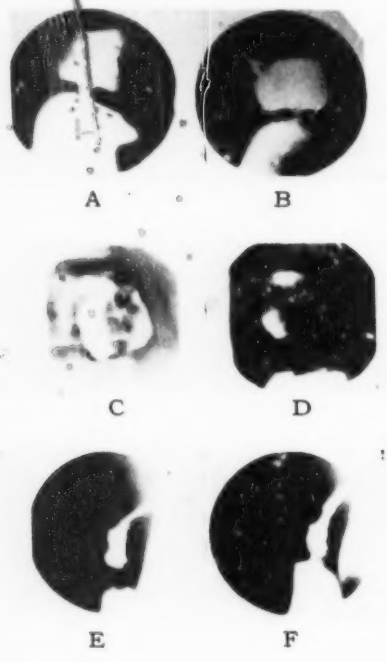


Fig. 1
(case 1)

A B. Duodenal cap filled to capacity: no ulcer deformity is seen.

C D. With dosed compression tiny ulcer niche and star-like convergence of folds. Mucosal swelling around ulcer ("en face niche").

E F. 2 spots in left ant. obl. projection: Ulcer appears as a tiny contour projection from anterior wall. ("profile niche").

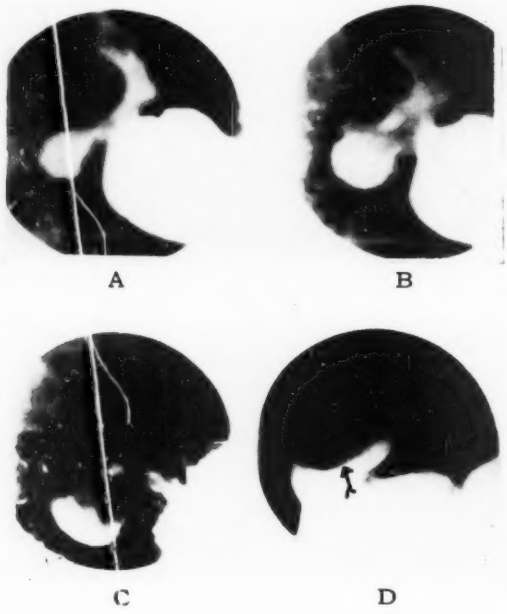


Fig. 2
(case 2)

A. Ulcer deformity.

B. Deformity and mucosal swelling.

C. Isolated barium filling of ulcer. Partially filled diverticular-like lower duodenal recess.

D. l.o.a. projection. Large anterior wall niche surrounded by "deeply retracted" (swollen) mucosa.

thinking that enables the radiological observer to deal with the great variety of appearances that occur in the pathologically changed relief and profile in various stages and complications of duodenal ulcer. (*Fig. 3.*)

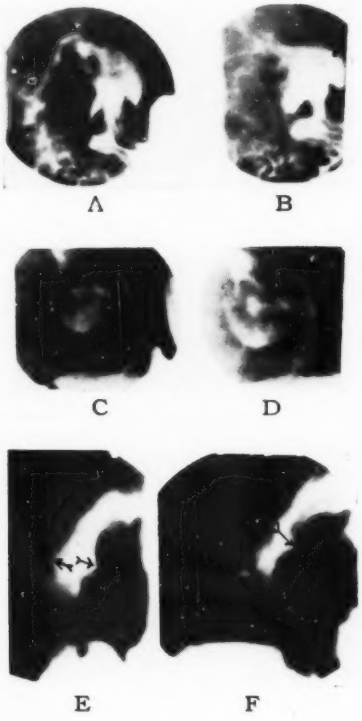


Fig. 3
(case 3)

A and B. Cap filled, slightly deformed, some mucosal swelling, no ulcer visible.

C and D. Two spot films with dosed compression. Two "en face niches" are seen side by side.

E and F. Two spot films in L.A.O. projection, Niches at anterior and posterior wall ("kissing ulcers").

I must now devote a few words of appreciation of the work of my former assistant, Dr. Klaus Pohlandt, with whom I worked closely during the years 1925-1932. It was at a time when we were experiencing certain difficulties in diagnosis of duodenal ulcer, which seemed to increase in direct proportion to the greater detail that was revealed by radiological examination. It seemed in certain cases that one had to pay for growing knowledge on the one hand, with increasing diagnostic doubts on the other. Not that the diagnostic failure was complete. The surgeon was usually quite satisfied with the general roentgen diagnosis of duodenal ulcer which he could but confirm. However, there were some cases where, for example, a small ulcer at the anterior wall was found when a large posterior wall ulcer was diagnosed, or an active large ulcer was found where only ulcer scarring was suspected from radiological appearances. Sometimes it happened that an ulcer was diagnosed and confirmed, but in quite a different location. These difficulties were obviously due to the failure to co-ordinate several single fluoroscopic and radiographic images to three dimensional impressions, from which alone the exact location and nature of an appearance can be determined. Pohlandt, being artistically inclined, introduced placticine models which were molded to fit all radiological observations of a certain case. By projecting these models by ordinary light as a shadow on a white screen, or by taking radiographs of them at different angles, reconstruction of fluoroscopic impressions to a three dimensional model was attempted.

We used these models very frequently and felt that the studies contributed greatly to our correct three dimensional thinking and the diagnosis of otherwise doubtful appearances. Pohlandt,[3] in a paper, which is scarcely known, but which I personally consider a most important contribution to the radiological diagnosis of duodenal ulcer, was able to show that the so-called "ring recess" of the duodenal cap is a rather frequent source of so-called "pseudo niches". These pseudo niches were, at that time, and still are in our time, very frequently misdiagnosed as ulcers, although they are produced by normal anatomical structures, or deformed anatomical structures, but not by the ulcer itself, as it might appear. (*Fig. 4.*)

Fig. 4
(case 4)

Radiol. demonstration of basal ring (arrows). Double arrow marks contour—overlapping ring recess simulating ulcer niche.

P = Pylorus.

When roentgen examination of the duodenum is done in such a searching fashion, it is amazing to what degree of exactness the actual anatomical findings might be determined. In fact, this exceeds in detail by far anything that the surgeon or pathologist is able to study. The surgeon sees the stomach from outside, the pathologist the dead specimen. Even the surgical specimen is seen by the pathologist usually at a time when many mucosal structures, present at the time of operation, have rapidly changed or disappeared. H. H. Berg was justified when, as far back as 1926, he compared the direct visualization of the inner surface of the gastro-intestinal tract by barium contrast with the study of the pathological specimen with the magnifying glass. I emphasize *with the magnifying glass*, for this is indeed often necessary to visualize certain minimal lesions which were much more clearly demonstrated by radiological evidence. It has now become more and more generally recognized that radiological findings are often superior to surgical exploration and even to the gross pathological examination of the specimen (Rigler). Although these remarks apply to certain cases of roentgen study of the alimentary tract in general, they are hardly anywhere else more justified than in roentgen examination of the duodenum, where, with modern technique of examination, the diagnostic reliability is not very far from one hundred percent.

SUMMARY

Spot-film technique in roentgen examination for duodenal ulcer requires careful fluoroscopic observation of the duodenum with varying degrees of (contrast) filling at all possible angles and instantaneous films of the characteristic radiological appearances taken at diagnostically important moments. The typical signs of duodenal ulcer, the ulcer niche, and other local signs of ulcer crater and ulcer scarring, are not often readily seen. Therefore, careful preparation of the radiological image under fluoroscopic observation, proper use of compression and palpation must precede the radiographic exposure in order to obtain films of diagnostic value.

A combined fluoroscopic and radiographic study of the duodenum in various projections necessitates a three dimensional interpretation of the radiographic images without which major errors are unavoidable. The ring recess at the base of the duodenal cap, if not identified as such, and the various other mucosal formations may produce appearances that will be mistaken for the crater of an ulcer.

BIBLIOGRAPHY

[1] Akerlund, A. Reontgenologische Studien ueber den Bulbus duodeni mit besonderer Beruecksichtigung des Ulcus duodeni. Acta radiol., Suppl. 1:261-62, 1921.

[2] Berg, H. H. Die direkten Roentgensymptome des Ulcus duodeni and ihre klinische Bedeutung, Ergebn. d. med. Strahlenforsch., Vol. 2:251-350. Leipzig: Georg Thieme, 1926.

[3] Pohlandt, K. Der Ringrezessus des Bulbus duodeni als Ursache typischer Fehldiagnosen von Ulkusnischen. Fortschritte auf dem Gebiete der Roentgenstrahlen, 44:425-441.

RECENT ADVANCES IN KNOWLEDGE OF THE BIOLOGIC EFFECT OF RADIATION

L. N. STEWART, M.D., D.M.R.T.
AND
JEAN BOUCHARD, M.D., D.M.R.E.
ROYAL VICTORIA HOSPITAL, MONTREAL

Little has been discovered in radiology which has so far materially altered the technique of irradiation as a therapeutic tool. We are still dependent on qualitative observations which were as well known thirty years ago as they are today. These may be epitomized in two major principles:

1. **Radio-Sensitivity:**

   (a) *Cell type:* The cells of some tissues are affected selectively more by a given dose of irradiation than the cells of other tissues exposed to the same dose under identical conditions;

   (b) *Generative activity:* Proliferative tissues show a more marked sensitivity than those without actively dividing cells.

2. **Physical-Biologic Correlation:**

   (a) *Tissue reaction time relationship:* A latent period, which varies for different types of response, elapses between exposure and the appearance of radiation effect;

   (b) *Dose time relationship:* The same dose of irradiation induces the same results according as to whether it is given at a high intensity for a short time or at a lower intensity over a longer time.

The knowledge gained from clinical trial and error within these principles constitutes the foundation of modern radiation therapy. Great advances have been made in radiation physics whereby one may deliver a given dose to a selected volume of tissue, but the stage has been reached when it is easier to administer a predetermined dose of radiation than to know precisely what biological change that irradiation will induce in the tissues.

It is suggested that unless our fundamental biological knowledge is elucidated and integrated with clinical problems, radiation therapy must be recognized as having reached its limitations as a therapeutic agent.

It is then timely to draw attention to certain phases of research in radio-biology which may have a bearing on the radiotherapeutic problems of the future.

The effects produced by their passage through living matter have been subjected to two methods of investigation, fundamental research and clinical research.

1. In fundamental research there has been an attempt to discover the exact mechanism by which radiation acts on living cells. This pathway embraces many academic problems and requires a long term programme carried on with specially designed experiments on selected materials which may ultimately be of greater value in the elucidation of basic intracellular phenomena.

2. The clinical or cytohistologic approach to the biological action is a short term method, which involves the study, not of the exact mechanism of the biological reaction to irradiation, but of their histological effect under given physical conditions.

Fundamental Research

It is perhaps not so surprising that the fundamental action of irradiation on living cells is not clear, when it is appreciated that its action on simple solutions is not yet fully understood. Scott[1] did considerable work on chemical changes induced in simple solutions, and noted that enormous doses were required to produce measurable chemical changes in irradiated solutions. He concluded that no pertinent chemical process could be involved in therapeutic radiation since recognizable changes could be obtained only with doses far above the maximum human tolerance dose. However, recent work by Dale[2] has shown the fallacy of this conclusion. Instead of looking for measurable chemical changes, Dale used biological indicators in the form of enzymes (carboxypeptidase). By such an experimental procedure, chemical changes induced by irradiation of an aqueous solution of these purified enzymes were magnified many times by the accompanying changes in biologicial actvity. Having found a sensitive indicator, Dale showed conclusively that for a given amount of energy absorbed in the whole solution, a constant amount of these enzymes was inactivated, irrespective of the concentration of the solution. It was natural then that he should speculate on the exact mechanism of enzymatic inactivation, and he, with others working on the same problem, has reached the conclusion that the effect has

nothing to do with the action of the irradiation on the solute, but is almost entirely due to effects resulting from the ionization of the solvent. It had been originally assumed that a new substance was formed, probably H_2O_2, as a result of ionization, but investigation proved that the formation of H_2O_2 was contrary to the known facts of physical chemistry. Recent work on this problem by Allsop[3] has supported the theory that the resulting reactions are initiated through the medium of an intermediate product derived from the solvent. Specifically, Lea[4], Burton[5] and Weiss[6] have shown that the intermediate products consist simply of free hydroxyl and hydrogen radicals which are produced by the ionization of the water.

This free radicle hypothesis is supposed to give a consistent simple explanation of many known radiochemical reactions in vitro. It also provides a chemical explanation of the so-called "protection effect" or phenomena. This protection effect can be briefly stated as follows: "When two solutes, (for instance, two different enzymes) each of which alone is radiosensitive, are irradiated together in aqueous solution, one is preferentially destroyed, and so "protects the other".[7] The substances which possess the highest relative "protecting power" appear to be those most likely to react with free hydroxyl radicles[8].

The experimental study of effects of radiation on the more complex conditions pertaining to the living cell, has included the use of such biological materials as Drosophila, Ascaris, viruses, bacteria, yeast, root tips, tissue culture, etc. With these, it has been shown that the effect of radiation is predominantly, but not exclusively, exerted on the nucleus of the cell, and the exact mechanism of such nuclear effect probably constitutes the chief problem pursued by research workers. It has long been known that one important effect on the nucleus was the striking arrest of cell division. Examination of the relative radiosensitivity of cells at various periods of the division cycle has shown that the prophase is the critical period of cell division in which radiation effect becomes manifest by alteration of physiology (differentiation, senescence or disintegration). Of late years, Henshaw[9] and others have shown that the stage of the prophase remains the critical period, irrespective of the status of the cell when irradiated.

Other avenues of investigation such as in genetics have afforded integration of knowledge from a different scientific field with benefit. It had long been known that x-rays had a sterilizing effect on the gonads. When Muller[10] demonstrated in 1928 that gene-mutations could be induced or accelerated by x-rays, great interest was aroused, and the geneticists entered into this field of research with considerable enthusiasm. The radiobiologists have borrowed these experimental procedures with their refined cytologic techniques, and have been able to show two different types of alteration that can be induced within the chromosomes:

One, a change in the linear arrangement of the chromosome threads, resulting from single or double breakages with recombination in new alignment, with or without loss of chromosome fragments. The other, changes in the composition of the gene units without disturbance of their position on the chromosome thread. The first type of alteration was the more attractive to radiobiologists because it lent itself well to quantitative study. The relation of dose to biological effect has become an important facet of the research problem.

Various workers have been led to believe that chromosome breakages are due to the passage of Alpha or Beta particles, protons or x-ray quanta through, or in the immediate vicinity of a chromosome, hence producing an adequate number of ionpairs within the chromosome. Such chromosome breakages are not necessarily lethal to the cell. Cell recovery and further mitosis is dependent on where the break occurs and the way in which the chromosome thread rejoins after the break. These conclusions naturally narrowed the problem down to an attempt to demonstrate the particular structure or molecure in which ionization has to be produced to induce cell death or change. The late D. E. Lea,[11] on the basis of deductions from the results of three independent lines of experiments postulated the well known target theory which states that in carefully controlled experiments, the biological action of radiation can be explained on the basis of the production of ionization in, or in the immediate vicinity of, some particular molecule or structure, as yet unknown. Search has been made for this molecule or other unit and certain generalizations have been made as to its chemical nature. Normal cell growth apparently is dependent on the synthesis of desoxyribosenucleatides which are the building stones of chromosomes. Furthermore, such synthesis apparently depends on the reduction of ribosenucleatides by enzymotic action, in a particular part of the chromosome, known as the heterochromatin. Mitchell[12] believes that the so-called targets, postulated by Lea, are the enzymes of the heterochromatin responsible for this normal nucleic acid metabolism.

The two theories developed from these investigations are not mutually exclusive. The one, that the effect of irradiation is indirect, due to ionization of solvent and liberation of free radicles, probably an hydroxyl, which is an energy carrier to some vital part of the cell, and which produces biological changes in the cell; the other, which postulates the existence of some molecule in or about the chromosomes as a target, in which ionization produces the observed biological changes (chromosome aberration, gene mutations, cell death, etc.) would seem to be

stating the same theory twice with only variations in mechanism of action. What this vital molecule is, has not been determined, but there is evidence to suggest that it is pertinent to nucleic-acid metabolism.

The quantitative relationship between dose and biological effect is a complex problem requiring an understanding of higher nuclear physics and mathematics. A few of the facts which have been put on a firm basis are first, that all biological effects are dependent on the property of ionization. The chemical bonds which hold a molecule together are constituted by electrons shared between the two atoms joined by the bond, and it is evident that the removal of such a bonding electron from a molecule will lead to dissociation or other chemical change. Removal of the bonding electron is possible by a quantum of x-rays, or particulate matter such as Alpha and Beta particles or protons.

Secondly, it has been shown, notably by Grey[13], that the biological reaction is not determined by the total number of ions, but rather by this spatial distribution, or what has come to be known as the "linear ion density" expressed as the number of ionpairs produced per micron of path. Therefore in discussing the production of various biological reactions, it is not necessary to be concerned with particular type of radiation used but rather to discuss the influence of linear ion-density, relative to changes induced.

To relate this idea of linear ion-density to the more practical problem of clinical radiotherapy, one may consider the values for the various sources of radiant energy used.

	Linear Ion Density	
20-30 million volt betatron	6.3	
Gamma radiation from radium with 0.5mm Pt filter	11	
1000 Kv x-rays	15	Usual
200 Kv	80	Therapy
30-140	100	Range

(From Gray, L. H.—*Brit. Med. Bull.*, Vol. 4, No. 1.)

It will be seen that the ion-density of the betatron and other such high energy generators may be bracketed with radium as used therapeutically. While the betatron and other million volt generators offer attractive possibilities from the standpoint of radiological technique, there are no self-evident grounds for expecting a marked difference in biological effectiveness between 30 million volts or 1 million volt x-radiation and radium.

Clinical or Cytohistologic Research

In the approach to these problems through the field of clinical or cyto-histologic research upon the biological effect of irradiation, Glucksmann[14] has been notable for his studies on squamous cell carcinoma of humans, particularly the cervix and the skin. The local response of various individual carcinomata was studied by examining serial biopsies taken before, during and after treatment and attempting a correlation of the histological changes with the subsequent clinical and pathological observations. Such biopsies were always taken from the growing edge of the tumor, and the most active area of the section was used for detailed examination. Glucksmann believes such selection of site makes the various biopsies of the same tumour comparable for cytological analysis. His critics maintain that every tumour shows variegated histology; therefore, serial sections are not comparable. Glucksmann carries out what may be designated as a differential count of the epithelial cells, depending on their stage of growth. He recognizes four cell-categories found in epithelial tumours: namely, the resting cell, the mitotic cell, the differentiating cell, and the degenerating cell, counting the proportion percent in each cell category as related to time. In a responsive tumour, there is a rapid decrease in the number of cells in mitosis, with eventually mitotic cessation in 6-10 days. There is a slower fall in the number of resting cells, accompanied by a corresponding increase in the differentiating and degenerating cells. His observations have confirmed the belief of others that irradiation can induce differentiation of cells. Glucksmann believes that he can predict by plotting such cell counts against time, whether or not treatment by radiation will be successful. Certain basal or squamous cell carcinoma of the skin, or squamous cell carcinoma of the cervix, will not respond to irradiation adequately irrespective of the dose. If such can be identified by this method, particularly in the cervix, surgery may be used while the neoplasm is still limited.

SUMMARY

(1) Irradiation is able to induce changes in biological material through an intermediate substance derived from the solvent, probably an hydroxyl radicle.

(2) In certain carefully controlled experiments a direct effect on some unknown specific part of the nucleus has been demonstrated.

(3) Radiation is able to induce cell differentiation.

(4) The biological action is dependent on linear ion density rather than the total ionization produced.

SOMMAIRE

(1) Les radiations peuvent provoquer des modifications sur les tissus vivants par l'action

d'un produit, probablement un radical hydroxyl, qui prend naissance dans le milieu.

(2) Dans un certain nombre d'expériences scrupuleusement contrôlées, on a observé une action directe sur des éléments spécifiques inconnus du noyau.

(3) Les radiations peuvent engendrer des différenciations cellulaires.

(4) L'action biologique dépend plutôt de la densité linéaire en ions que de la somme d'ionisation totale engendrée.

REFERENCES

1. Scott, C. M., Spec. Rep. Ser. Med. Res. Counc. 223, 1937.

2. Dale, W. M., Brit. J. Radiol. 16, 171- 1943.

3. Allsop, C. B. Brit. J. Radiol. Supp. No. 1, 43, 1947.

4. Lea, D. E., Actions of Radiation on Living Cells, 1946.

5. Burton, M., Journ. Phys. Coll. Chem. 51, 611, 1947.

6. Weiss, J., Brit. Journ. Rad. Supp. No. 1, 56, 1947.

7. Allsop, C. B., Brit. Journ. Rad. 21, 73, 1948.

8. Waters, W. A., Brit. Journ. Rad. Supp. No. 1, 63, 1947.

9. Henshaw, P. S., Am. Journ. Roentgenol., 43, 907, 1940.

10. Muller, H. J., Science, 67, 82, 1928.

11. Lea, D. E., Actions of Radiation on Living Cells, 1946.

12. Mitchell, J. S., Brit. J. Radiol., 16, 339, 1943.

13. Gray, L. H., Brit. Med. Bull. Vol. 4, No. 1, 11, 1946.

14. Glucksmann, A., Brit. Med. Bull. Vol. 4, No. 1, 26, 1946.

THE APPENDIX : A STUDY COMPARING RADIOLOGICAL DIAGNOSIS WITH OPERATIVE, ANATOMICAL AND PATHOLOGICAL FINDINGS AND SUBSEQUENT CLINICAL RESULTS*†

L. P. BELISLE, M.D.
MONTREAL, CANADA

A number of attempts have been made to correlate the clinical end results, or the so-called roentgen signs of the diseased appendix, with laboratory and pathological findings. These have not proven successful. Too many patients still had their symptoms after the appendix has been removed, even when these appendices showed gross macroscopic and usually microscopic changes.

When one considers what has been written about appendicitis, the question arises as to whether our so-called roentgen signs might prove of value. I tried to answer this question by sending out a questionnaire to the patients whom I had examined. Between June 1945 and June 1948, 1,363 patients had had a gastro-intestinal examination for a variety of conditions. Of these, 255 exhibited in a definite manner the so-called roentgen signs of appendicitis. Of these 255, 193 answered the questionnaire, and of the 193, 74 had had their appendices removed. The following summary indicates the findings:

No. of patients	*No. of appendectomies*	*No. of patients not operated upon*
193	74 (38%)	119 (62%)
Symptom free	36 (50%)	31 (26%)
Improved	30 (41.6%)	57 (47%)
Not improved	6 (8%)	32 (26.9%)
Results satisfactory	(91.6%)	(73%)
Results poor	(8.3%)	(26.9%)

This would seem to indicate the value of roentgenological investigation in helping the surgeon to come to a decision which might be of importance to the well-being of the patient. Consequently, it seemed a logical thing first, —to study in detail some of the objections most commonly encountered against roentgenological investigation; second,—to review these findings and to classify them in the order of their importance on the basis of the answers to our questionnaire.

Due to limitation of space, I must omit any consideration of roentgen methods, as these should be familiar to radiologists.

The objections to the value of the roentgen examination can be classed under three headings: 1. Anatomical; 2. Physiological; 3. Clinical.

Anatomical

The primary condition required for a roentgenological examination is that the organ to be explored must be visible. The objection raised is that malformations or congenital anomalies (short meso-appendix causing appendiceal kinks and fixation) would not allow the appendix to be visualized, and if visualized would cause the appendix to be interpreted as pathological. According to Mallory, the percentage of anomalies and malformations, such as a short meso-appendix, is between 1 and 2%. Regarding fixation of the appendix due to secondary causes, one cannot think that there would be a pathological lesion without pain. One anatomical objection is that of the low caecum, which in many instances may be superimposed upon the appendix itself. We must recognize that in this condition our examination would be useless. One can succeed, however, by traction and gentle pressure in displacing the caecum upward and thus demonstrating the barium-filled appendix.

Physiological

The fact that the physiology of the appendix is far from being known causes considerable uncertainty in any conclusions drawn from the visibility or invisibility of the appendix, whether it was painful or painless by palpation. As to pain, a painful appendix is always pathological, though careful differentiation must be made from that pain due to typhlitis and colitis.

*Read at Mid-Winter Session of the Canadian Association of Radiologists, January 1950, Montreal.

†Original paper published in French in *L'Union Médicale du Canada*, Volume 78 (1045), September 1949.

Clinical

Appendicitis may be stimulated by many other abdominal conditions and it might, therefore, appear that the x-ray examination would seem to many as just one more confusing element. To this objection, one may answer that the more difficult it is to arrive at a diagnosis, the more we should use all the diagnostic means at our disposal, including a complete gastro-intestinal series as this helps in the majority of cases to a clearer understanding of the clinical situation. To answer the question as to whether the pains referred to the umbilical or epigastric regions resulting from compression of the abdomen under fluoroscopic observation tend to confuse the results of the roentgen examination, L. R. Braithwaite[1] describes an abnormal lymphatic connection between the appendicular region and the duodenal gastric region, and it is quite possible that this would explain much, if not all, of the peculiar radiation of pain. To the question as to whether the right ovary in a woman becomes a complicating element in determining by roentgenological means the origin of appendicular pain, we must admit that in most females the roentgen efforts are useless without a satisfactory gynaecological investigation. This is particularly difficult if the female patient has a caecum which is unusually low in the pelvis. In these cases it is necessary to displace the caecum by steady compression and disengage the appendix from the pelvic area if possible, and thus by continuous pressure maintain the caecum in a fairly high position and so eliminate the possibility of confusion with the pain of a tender ovary. In the female patients, a careful history will often help to determine whether there is a menstrual periodicity of pain or whether it is bilateral.

The last, but not the least, objection which is based on the possibility that the roentgen examination represents precious time lost for the surgeon, must be recognized as a valuable objection, as in many of our cases there was precious time lost for the surgeon, especially as the roentgen picture was not suggestive of appendicitis. In acute cases with the onset of complications, it would be very undesirable to destroy by manipulation the wall of an abscess due to an acute infection. It must be understood, therefore, that in the main this paper deals with the so-called chronic appendicitis, which is the only form of appendicitis that might benefit by roentgen examination.

Let us, therefore, analyse our most common findings and criticize them in the light of this investigation.

1. Invisible Appendix

Early in the examination of the appendix it was seen that an invisible appendix did not necessarily mean a pathological appendix. As a matter of fact, in 193 of the cases reported above, only one-third of the appendices was clearly visible when the roentgen findings suggested a pathological lesion. Even though one cannot draw direct evidence from the invisible appendix, a pathological lesion of the appendix can be assumed if such possibilities are ruled out elsewhere and particularly if the tenderness is sharply located along the inner margin of the caecum. As to the functional disturbances that are supposed to accompany chronic appendicitis, such as caecal or ileal spasm, caecal or ileal stasis, pyloro-spasm, aerogastry, gastric retention, etc., they surely exist and these were encountered in our group of cases. They can only be recorded, however, as contributive factors in determining the condition of the appendix.

2. Visible Appendix

The appendix, when visible, yields information as to its shape, direction, calibre, length, mobility and pain.

3. Shape

If one omits the anomalies mentioned above, the shape of the appendix varies according to the degree of pressure exerted upon it and to the peristaltic conditions of the neighbouring loops of bowel. Definite fixation of the appendix may mean a peri-appendicular sclerosis, something which appeared rather negligible in our series unless it was associated with an unusual direction of the appendix. An abnormal retention of barium is not in itself a sign of disease unless accompanied by tenderness. Two cases of 48-hour stasis are still not improved following operation, and one case of stasis with tenderness at the time of examination is now symptom-free.

4. Direction of Appendix

A normal appendix may be stretched in any direction: toward the liver, toward the duodenum, toward the umbilicus, within the lower pelvis, toward the right ovary, provided it has no adhesions with any of these organs. In the last case, one must assume a pathological lesion.

5. The Upright Position

The upright position of a retro-caecal appendix deserves special mention. This is most probably proof of disease. We had, in our series, ten of these cases who were subsequently operated upon, seven of whom are now absolutely symptom-free, two of whom are improved and one not improved. All these cases complained of dyspepsia, seven of whom showed no tenderness on palpation while five had no, or very little, evidence of microscopic inflammatory changes. These findings would tend to make us think that the dragging effect of adhesions might be as important as inflammation in reflex disorders of the stomach.

6. Mobility of the Appendix

The importance of this is rather hard to estimate because one must keep in mind the possibility of a congenital fixation, unless to fixation, tenderness can be elicited, as mentioned above.

7. Calibre of the Appendix

The calibre of the appendix varies within wide limits normally, but narrowings which were constant were proven to be organic strictures in the pathological reports, few of them containing scattered neurogenic infiltrations along the wall of the appendix. Stercoliths may modify the calibre of the appendix, usually by enlarging the distal portion of the appendix where they are more or less clearly visible. They are of important pathological significance since they are present in 50% of perforations of the appendix and in 80% of the abscesses and gangrene formation.

8. Length of the Appendix

Abnormal length seems to be a definite factor in a pathological lesion probably by favouring stasis and infection in situ. We had eight of these cases. A few pathological reports made no mention of inflammatory changes whatsoever, and there was not even tenderness on palpation. All of these cases, however, are now symptom-free.

9. Tenderness or Absence of Tenderness

It is commonly admitted that tenderness is the most decisive factor in a pathological lesion of the appendix, but it must also be stressed that in some instances an absence of tenderness is also compatible with a diseased appendix. The dragging effect of adhesions, the peri-appendicular sclerosis, retro-caecal position, abnormal length, are all characteristics which have proven, in our series by the clinical end results, to be definite indications of a diseased appendix.

If we were to summarize the results of our inquiry, it would seem logical to admit the following:

1) Visibility or invisibility of the appendix is irrelevant to disease of the appendix.

2) Painful fixations of the appendix are almost always evidence of disease; likewise a prolonged stasis of barium in the appendix without evidence of stasis of barium in the colon.

3) Definite and constant narrowings of the calibre of the appendix almost constantly refer to kinks and adhesions; sometimes they mean a diffuse neurogenic infiltration, but, as a rule, clinical results are not satisfactory in these latter cases.

4) The upright retro-caecal appendix or the abnormally long appendix would seem to indicate disease of the appendix, since all our patients of this category have been cured by operation.

5) Pain referred to the umbilicus or the epigastrium on palpation of the appendix seems to be difficult of interpretation without a definite relation to an observed condition of the appendix.

6) The clinical end results based on the so-called roentgen signs would seem to compare favourably with those of surgical statistics. For example, improvement is reported by the following:

Block 31%, Bourgeois 26% Connell 22%
Gibson 24%, Lewis 33%.

The present inquiry, 8.3% improvement.

SUMMARY

I. There are general objections to the roentgenological investigation of the appendix and these are answered.

II. The method of explanation of exploring the appendix by roentgenological means was not discussed due to space limitation.

III. The findings reviewed and classified in a degree of importance, according to pathological and post-operative findings as well as clinical end results as recorded by a questionnaire investigation.

RÉSUMÉ

I. Réponse aux objections générales contre l'exploration radiologique de l'appendice.

II. Discussion du choix d'une méthode et sa description ne sont pas inclus.

III. Critique des constatations qu'elle permet, et fixation par ordre d'importance des caractères pathologiques retracés par l'examen, à la lumière des révélations opératoires, histo-pathologiques et de l'état clinique ultérieur des patients.

BIBLIOGRAPHY

(1) Braithwaite, L. R., *Brit. J. Surg.*, 11:7-26, 1923.

ALLAN BLAIR MEMORIAL FELLOWSHIP

The Allan Blair Memorial Fellowship, for the two years beginning July 1950, has been granted to Dr. Donald Cameron MacEwen, formerly of Regina and who had been an interne under the late Dr. Blair. He will continue his studies in Great Britain and other centres in Europe with particular attention to gynaecological cancer.

CANADIAN-BRITISH EXCHANGE FELLOWSHIPS

The Canadian-British Exchange Fellowships for study in the United Kingdom next summer have been awarded to Dr. W. T. Dingle of the Winnipeg General Hospital and Dr. T. G. Stoddart of the Ottawa Civic Hospital.

The first two Canadians to obtain scholarships under the two-way plan of the National Cancer Institute, were Dr. Clifford Ash of the department of radiology and Ontario Institute of Radiotherapy, Toronto General Hospital, and Dr. Jean Michon, department of radiology, Notre Dame Hospital, Montreal, who now are finishing their two years' studies overseas.

Two British men, nominated by the British Empire Cancer Campaign, will study in Canada as the first overseas recipients of the exchange fellowships. They are Anson Quinton of Birmingham, physicist, and Dr. Leonard Joseph Zatman of Manchester. They will proceed to Canada shortly.

KINSMEN CLUB FELLOWSHIP

Dr. Paul Emile Côté, of Quebec, has departed for Europe on a special Kinsmen Club Fellowhip for special study of radiation therapy in various centres for one year.

Dr. R. M. Cunningham, formerly of Saskatchewan, has been granted a special Kinsmen Club Fellowship to complete his current year of study at the Royal Cancer Hospital, London, under Professor D. W. Smithers and Professor W. V Mayneord.

EDITORIAL NOTICES

Articles will be accepted on condition that they are contributed solely to this Journal and should be sent to the Editorial Board, Journal of the Canadian Association of Radiologists, 1535 Sherbrooke St., W., Montreal 26, Quebec, Canada.

Manuscripts must be typewritten on good quality paper, double spaced with one-inch margin. Original copy should be sent and the author should retain a carbon copy as the original will not be returned. The author should always place his full name somewhere on the manuscript—this is important. The Editorial Board reserves the right to make literary corrections. Due to limitation of space, each paper will be restricted to 4 printed pages. The equivalent of two typewritten pages, double spaced, is one printed page.

Illustrations are limited as to the number that can be accepted without charge to the author. Photographic prints of plates or slides must be on glossy paper and should be in the negative phase, as that of the original roentgenogram. The ideal size for fine reproduction is 5 x 9. Drawings and charts for reproduction should be made in black (never blue). All photographs and drawings intended for illustrations should be mounted, numbered, the top plainly indicated, and an abbreviated title of the paper placed on the back of each one. Legends for illustrations should be typewritten in a single list, double spaced, with numbers corresponding to those on the photographs and drawings.

References in a bibliography should include the following information in the order indicated: Name of the author with initials; title of the article; name of the periodical, year, volume and pages. It is requested that the authors use the following as a model: 1. Olcott, C. T., and Dooley, S. W. Agenesis of the lung of an infant. Am. J. Dis. Child., 1943, 65, 766-780.

The month should be given if the reference is to an issue of the current year. An alphabetical arrangement of authors is preferred.

Reprints cannot be supplied without charge, but will be supplied at cost if authors will indicate their requirements at the time that proofs are returned.

Copyright: All matter in the Journal is covered by copyright, but reproduction in other publications will usually be approved if permission is requested and proper credit given.

NOTES DE LA REDACTION

Dates de parution:—Le journal paraîtra trimestriellement, soit les 1ers mars, juin, septembre et décembre de chaque année. Les articles devront être remis au plus tard le 5 du mois précédent.

Collaborateurs:—Les articles ne seront acceptés qu'à la condition d'être exclusifs à ce journal et ils seront protégés par des droits d'auteurs; mais, de façon générale, la reproduction pourra être autorisée sur demande, pourvu qu'on en donne crédit à notre journal. Tous les articles devront être adressés au Comité de rédaction, Journal de l'Association canadienne des radiologistes, 1535 ouest, rue Sherbrooke, Montréal 26.

Manuscrits:—Les manuscrits devront être dactylographiés sur papier de bonne qualité, à double interligne et en laissant une marge d'un pouce d'espace des quatre côtés. L'auteur devra envoyer l'original et garder un double au carbone, car les originaux ne seront pas retournés. L'auteur devra toujours écrire son nom au long ainsi qu'un abrégé du titre de l'article sur chacune des pages du manuscrit (ce détail est important).

On publiera des résumés français des articles en langue anglaise de même que des résumés anglais des articles en langue française.

Faute d'espace suffisant, les articles seront limités à 4 pages d'imprimerie: une page d'imprimerie équivaut à environ 2 pages dactylographiées, double espace.

Illustrations:—Le journal ne pourra publier gratuitement qu'un nombre limité d'illustrations. Dessins et graphiques devront être tracés en noir (jamais en bleu). Les reproductions de clichés, planches, etc., devront être présentées sur papier glacé et à l'état de négatifs comme les originaux des clichés radiographiques. Les dimensions idéales, pour reproduction, sont 5 x 9. Tous les dessins et photographies devront être encadrés et porter un numéro; le haut de la gravure sera clairement indiqué et celle-ci portera, au verso, le titre de l'article qu'elle accompagne. Les légendes expliquant les illustrations seront dactylographiées à double espace, sur une liste séparée, chaque légende portant, en regard, le numéro correspondant à celui qui apparaît sur l'illustration.

Références:—Toute référence bibliographique comprendra les renseignements suivants, dans l'ordre indiqué: Nom de l'auteur, suivi de ses initiales, titre de l'article; nom du journal, année, volume, pages. On est prié d'utiliser le modèle suivant:—1. Olcott, C. T., and Dooley, S. W. Agenesis of the lung of an infant. Am. J. Dis. Child., 1943, 65, 766-780.

Si la référence est tirée d'une publication de l'année courante, on devra indiquer le mois. On fournira, de préférence, une liste alphabétique des auteurs cités.

Tirés à part:—Les tirés à part ne pourront être faits gratuitement, mais on les fera au prix coûtant pourvu que les auteurs veuillent bien donner leur commande en retournant les épreuves.

EDITORIAL

In a little book called, "Plain Words—A Guide to the Use of English", by Sir Ernest Gowers†, there appears a delightful and instructive chapter on the choice of words. Sir Ernest begins this chapter with a quotation from Ivor Brown which we include, as well as the author's footnotes:

> 'The craftsman is proud and careful of his tools: the surgeon does not operate with an old razor-blade: the sportsman fusses happily and long over the choice of rod, gun, club or racquet. But the man who is working in words, unless he is a professional writer (and not always then), is singularly neglectful of his instruments.'
>
> "IVOR BROWN".

"The basic fault of present-day writing is a tendency to say what one has to say in as complicated a way as possible. Instead of being simple, terse and direct, it is stilted, long-winded and circumlocutory; instead of choosing the simple word it prefers the unusual.

"Ivor Brown, a connoisseur of words, has invented several names for this sort of writing. In one book he calls it 'jargantuan', in another 'barnacular' and in another 'pudder'.* If anyone wants to know more precisely what these words mean (and all should) he should study the translation of the Lord's Prayer into pudder in *Say the Word*. The specific forms that it commonly takes in official writing will be examined in the following three chapters. In this one we are concerned (if I may borrow a bit of pudder from the doctors°) with the aetiology of the disease and with prescribing some general regimen for the writer that will help him to avoid catching it.

"Why do so many writers prefer pudder to simplicity? It seems to be a morbid condition contracted in early manhood. Children show no signs of it. Here, for example, is the response of a child of ten to an invitation to write an essay (its genuineness is guaranteed) on a bird and a beast:"

> 'The bird that I am going to write about is the Owl. The Owl cannot see at all by day and at night is as blind as a bat.
>
> 'I do not know much about the Owl, so I will go on to the beast which I am going to choose. It is the Cow. The Cow is a mammal. It has six sides—right, left, an upper and below. At the back it has a tail on which hangs a brush. With this it sends the flies away so that they do not fall into the milk. The head is for the purpose of growing horns and so that the mouth can be somewhere. The horns are to butt with, and the mouth is to moo with. Under the cow hangs the milk. It is arranged for milking. When people milk, the milk comes and there is never an end to the supply. How the cow does it I have not realized, but it makes more and more. The cow has a fine sense of smell; one can smell it far away. This is the reason for the fresh air in the country.
>
> 'The man cow is called an ox. It is not a mammal. The cow does not eat much, but what it eats it eats twice, so that it gets enough. When it is hungry it moos, and when it says nothing it is because its inside is all full up with grass.'

"The writer had something to say and said it as clearly as he could, and so has unconsciously achieved style. But why do we write, when we are ten, 'so that the mouth can be somewhere' and perhaps when we are thirty 'in order to ensure that the mouth may be appropriately positioned environmentally'?"

---

†From *Plain Words—A Guide to the use of English* by Sir Ernest Gowers, Chapter 5, *The Choice of Words* (1), pages 30 and 31, published by His Majesty's Stationery Office, London, England.

"**Jargantuan* and *barnacular* are self-explanatory; *pudder* is taken from Lear's prayer to 'the gods who keep this dreadful pudder o'er our heads.'

"°Puddery seems to be regrettably increasing in medicine. In my lifetime I have seen the *mad-doctor* pass through the chrysalis of *alienist* into the butterfly of *psychiatrist*. This is perhaps excusable, but why have *walking cases* suddenly become *ambulants?* Some seventy years ago a promising young neurologist made a discovery that necessitated the addition of a new word to the English vocabulary. He insisted that this should be *knee-jerk*, and *knee-jerk* it has remained, in spite of the efforts of *patellar reflex* to dislodge it. He was my father; so perhaps I have inherited a prejudice in favour of home-made words."

Packed Power for Modern Techniques

PHILIPS DX3
FOUR-VALVE DIAGNOSTIC UNIT

This four-valve diagnostic unit by Philips positively compels attention.

Its fine engineering features, its guaranteed performance and proved reliability place it unmistakably in the distinguished class. Proof that in the "DX3" progressive radiological opinion has been very well interpreted is evident from the enthusiasm with which it has been received.

Users praise the linear kV scale of which the reading remains valid, irrespective of the load. They like, also, the electronic timer, and the precision now possible with repetitive techniques by the introduction of mains frequency compensation. They endorse, too, the "Quantic" automatic control which exercises constant vigilance in the "safe maximum" region and protects the tube against overload.

The "DX3" is of medium output—100 kVp and up to 300 mA fitted with oil immersed valves and arranged for two tubes—stationary or rotating anode.

WRITE FOR FULL INFORMATION

. . . Medical X-Ray Apparatus . . .

PHILIPS

PHILIPS

INDUSTRIES LIMITED

PHILIPS HOUSE • PHILLIPS SQUARE • MONTREAL

VANCOUVER • WINNIPEG • TORONTO • QUEBEC CITY • HALIFAX